Response of transpiration, net photosynthesis, and growth of *Robinia pseudoacacia* L. to different soil moisture regimes in a lysimeter experiment

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Abstract

Soil moisture dynamics together with the evaporative atmospheric demand are key factors for the study of the soil-plant-atmosphere interaction in relation to the primary production. Our aim was the evaluation of biomass-transpiration of young black locust trees with a newly developed wick lysimeter coupled with an automatic irrigation system. The volumetric soil content for the three different treatments was maintained at 7%, 10%, and 14%. Plant response plants to water availability, and climate, in terms of transpiration, growth rate, area leaf and biomass production, is investigated at whole plant level. Furthermore, the ecophysiological response will be integrated into the soil-plant-atmosphere modeling. Therefore, we determined leaf transpiration and net CO2 exchange under different water vapour pressure deficits and air temperatures with a portable gas exchange system. Trunk, and branches diameter, together with the branches length were measured monthly during the entire vegetation period (1st June to 11 September). Under well-watered conditions black locust is not a water saving tree and has a high transpiration rate, even on leaf level. The mean cumulative transpiration during the vegetation period for the Robinia was 240 liters (7%) 385 (10%) and 587 (14%), respectively. On leaf level, black locust showed high transpiration rates up to 10 mmol m^{-2} s^{-1}, while under water limitation leaf transpiration decreased to 5 mol m^{-2} s^{-1}. The stomata closure reduced the net CO_2 uptake. Its water use efficiency (WUE) is lower (2.41 kg m^{-3}), compared to other fast-growing trees like willows (5.5 kg m^{-3}) or poplars (4.1 kg m m^{-3}). Under well watered conditions soil water resources Robina shows a high water consumption, however, the tree can be consider as a drought tolerant tree. The decrease of transpiration was followed by a reduction of the of the growth rate. The secondary branches longitudinal growth of the 7% treatment, at the end of the vegetation period was reduced of the 30% compared to the 14%. Also the diametric increment of the secondary branches was reduced of the 31 and 35% for the 10% and 7%. No significant difference where shown in term of the diametric increase of the trunk between the treatments. Water limitation reduced also the total leaf area. The total leaf area of the plants grown under water stress, (7% and 10%), was reduced at 40% and 57% respectively, compared to the well-watered plants (14%).

References

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